AccessibilityUtil: A Tool for Sharing Experiences About Accessibility of Web Artifacts

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ABSTRACT
Existing guidelines on how to develop web applications with accessibility are currently not applied in many organizations. The lack of "closeness" of these guidelines to the developers is one of the most significant reasons for this scenario, as developers often do not know them or find it difficult to apply them. As a proposed solution to increase the use of guidelines in development practices, we present a proposal of a collaborative tool for sharing and disseminating experiences. The proposal is based on capturing and disseminating Design Rationale (DR) related to experiences with developing web artifacts, following the Web Content Accessibility Guidelines (WCAG) 2.0.

Categories and Subject Descriptors
D.2.2 [Design Tools and Techniques]: User Interfaces; H.5.4 [Hypertext/Hypermedia]: User issues;

General Terms
Design, Human Factors.

Keywords
Accessibility, WCAG 2.0, Collaboration, Design Rationale

1. INTRODUCTION
Millions of people have limited access to content and functionality available on the web due to interaction artifacts that are not in accordance with accessibility guidelines. The challenge in this area is to design elements of the web sites that enable any user to perceive, understand and interact with its content [13][20][24].

Considering the various technologies such as desktop computers, notebooks, tablets and cell phones, accessibility can become more complex to developers; this can make it be partially or completely ignored by developers [7][15][1].

The aim of web accessibility is to provide equal opportunities for all, to have access to the extensive content available on the online environments for education, business, government, commerce and entertainment.

The motivation for this research is directly related to the issue of how to solve or mitigate the problem of non-use of web development best practices, especially regarding the W3C accessibility guidelines, by developers. Currently, in fact, many barriers are found [15][1][7][24].

One problem is the lack of efficient mechanisms to assist the developers, informing and supporting them to make effective use of successful experiences during the process of web applications [20][24]. Whereas a development team often has a lack of standardization in the way of implementation, not being consulted prior experience and with little documentation of the well-succeeded cases, which would be very useful for facilitating the development concerning the accessibility guidelines.

According to Freire, Russo and Fortes (2008), despite the efforts at developing the accessibility guidelines, the developers often do not know them, the organizations have not been involved in applying them and the authoring tools do not provide adequate support to their employment. The research describes a study that involved 605 people engaged in web development projects. They were asked for answering a survey; 48% of respondents did not use any method to incorporate or evaluate accessibility in their projects [7].

Based on the problematic context of the developers not being aware of the accessibility guidelines, we propose a collaborative tool for helping an organized exchange of experiences on development of web interaction artifacts concerning the accessibility guidelines. We have used a Design Rationale (DR) method, as part of the development process that requires the documentation of decisions, discussions, argumentation and comments on the final product.

In the DR proposal the design decisions and their impacts are registered as good or bad. This is because such decisions could lead to success or failure of a project. Documentation is important to build a knowledge base for future projects by avoiding rework and enabling better decisions [16].

Another point to consider is that this type of approach to design and its dissemination is common to human experience. Most people often observe others' comments as builders of knowledge, in this case features of using guidelines in projects to improve accessibility.

The purpose of this paper is to present concepts and results of the study, planning and development of our tool, highlighting the discussion about how DR and collaboration can be useful in the field of development using best practices. Thus and because the limited size of this paper, we do not we focus on the further implementation details, but on the design and rationale of the proposed development.

The proposed tool for promote discussion and experience sharing about accessibility, called AccessibilityUtil, is available online in
Portuguese and English, to expand the contribution of aggregation and knowledge of experts from around the world. The overall aim is to allow the dissemination of information and make resources available to other developers, providing mechanisms to assist development with good accessibility.

In Figure 1 we present the conceptual first attempt for the picture of the proposed tool.

![AccessibilityUtil.com](http://www.accessibilityutil.com/)

**Figure 1 – AccessibilityUtil concept and collaboration model**

To clarify the usage scenarios resulting from the tool use and its contributions, we show the following 3 main examples of possible use:

1. A developer wants to insert and share a technique related to a particular pattern or tag;
2. A developer who used a technique and has positive or negative comments about it;
3. A developer wants to use a certain pattern and will consult the tool to ponder over existing techniques and what other developers and experts argue about them before using.

With the collaboration model proposed, we intend to achieve a number of relevant assessments and contributions for each artifact registered with the purpose to enable developers and other interested persons to consult a database aiming to support the creation of websites more accessible using official guidelines. The tool is available at the URL "http://www.accessibilityutil.com/" and can be used from the creation of a user account to full access to view and contribute with artifacts and assessments.

This paper is organized as follows: Section 2 presents the concept of web accessibility, with the problems involved and a summary of accessibility guidelines. In Section 3 we present the concepts of DR and then show the methodology for the research we conducted in Section 4. Section 5 presents a summary of the development of the supporting tool to our proposal. Finally, in Sections 6, 7 and 8, we discuss the results, related work and conclusions, respectively.

## 2. WEB ACCESSIBILITY

Accessibility can be broadly interpreted as the possibility of using some resource universally, without barriers or with alternative ways to access and use. In web context, the contents of the pages are this resource. So this concept is related to every user, using every agent, can understand and interact with the offered content [19][21].

In general, there are three fundamental reasons why organizations must make their sites accessible:

**Social reasons:** organizations must be motivated to be socially responsible and work to eliminate discrimination and promote the human rights [10].

**Commercial reasons:** there is no economical justification for organizations to alienate about 10% of potential users who may have some disability [10]. Companies having an inaccessible website may result in the migration of disabled users to competing sites.

**Legal justification:** in 1993, the United Nations released the *Standard Rules on the Equalization of Opportunities of Persons with Disabilities*. This document is only a guideline and includes the recommendation that nations must "develop strategies to make information services and documentation for different groups of people with disabilities" [2]. In Brazil there is the 5296’s Law Decree from December 2nd, 2004 which regulates, in its article 47, the obligation of accessible governmental websites within one year. After approximately seven years what we can see is that we are still far away from what was regulated.

### 2.1 Issues overview

There is a significant gap of knowledge from developers and experts in accessibility. Most programmers have no necessary knowledge or experience to ensure that their code attends the accessibility requirements. It is a common practice to consider accessibility in a project developing advanced stages or when applications are already coded. At this point, making applications accessible is a real challenge of redesign and reprogramming.

Martín, Cechich and Rossi (2011) ponder about the importance of modeling accessibility requirements in the development early stages and not only in evaluations after the product performed [13]. An essential feature for them is that the application of accessibility concepts requires a special treatment during web developing. There’s an idea that must predominate accessibility global features that are independent of device and implementation types. Thus, they propose an independent aspect-oriented approach for inclusion of accessibility good practices in web development.

These authors also comment that the use of past experiences reports are very important for the accessibility successful solutions reuse, saving time and investment from developers. Thus, it is indicated the use of patterns and templates. The design support must be performed with a universal design for an efficient inclusion in the project [1].

According to Bigham, Brudvik and Zhang (2010) very few developers have been trained explicitly for accessible pages creation. Evaluate pages using assistive technology may reveal problems, but these software take time to install and can be complex for this use.

To facilitate the developers learning, these authors propose an accessibility approach by demonstration. The idea is that one person using an assistive technology may find problems and report it to the website developers.

Creating accessible content can be subjective and a difficult task for developers, who are mostly not trained in accessibility. Guidelines and standards serve as an entry point, but may not capture many factors that influence the accessibility and usability of a page [3].

2.2 Web Content Accessibility Guidelines (WCAG)

Aiming to explain more about how to produce accessible content for the Web, W3C, through its Web Accessibility Initiative (WAI), released a collection of accessibility guidelines, called Web Content Accessibility Guidelines (WCAG). These guidelines represent recommendations to produce accessible web content (texts, images, forms, sounds) to persons with disabilities, including blindness and low vision, deafness, deafness and hearing impairments, learning difficulties, dyslexia, cognitive limitations, limitations of movement, inabilities to speak, photosensitivity and combinations thereof.

These guidelines are in its 2.0 version since December 2008. The goal is that they serve to supporting developers and subject to testing by automated tools and humans.

Its composition is hierarchical, being on top of its structure are four principles underlying 12 guidelines and 61 success criteria. A summary of these principles and guidelines is shown below [21]:

**Principle 1: Perceivable** - information and user interface components must be presentable to users in ways they can perceive. Its guidelines are:

**Guideline 1.1 - Text Alternatives:** provide text alternatives for any non-text content so that it can be changed into other forms people need.

**Guideline 1.2 - Time-based Media:** provide alternatives for time-based media.

**Guideline 1.3 - Adaptable:** create content that can be presented in different ways without losing information or structure.

**Guideline 1.4 - Distinguishable:** make it easier for users to see and hear content including separating foreground from background.

**Principle 2: Operable** - user interface components and navigation must be operable. Its guidelines are:

**Guideline 2.1 - Keyboard Accessible:** make all functionality available from a keyboard.

**Guideline 2.2 - Enough Time:** provide users enough time to read and use content.

**Guideline 2.3 - Seizures:** do not design content in a way that is known to cause seizures.

**Guideline 2.4 - Navigable:** provide ways to help users navigate, find content, and determine where they are.

**Principle 3: Understandable** - information and the operation of user interface must be understandable. Its guidelines:

**Guideline 3.1 - Readable:** make text content readable and understandable.

**Guideline 3.2 - Predictable:** make web pages appear and operate in predictable ways.

**Guideline 3.3 - Input Assistance:** help users avoid and correct mistakes.

**Principle 4: Robust** – the content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. It guideline is:

**Guideline 4.1 - Compatible:** maximize compatibility with current and future user agents, including assistive technologies.

For each one of the 12 guidelines, there are several success criteria to be tested. The W3C documents all criteria in WCAG and outlines solutions to comply them in different applications [21], though they remain far from practical reality of most web application developers, without a direct connection with the various existing artifacts.

Besides this problem, those who know of the existence of these guidelines often do not follow them, by its demand a greater effort in developing applications, considering a relatively small audience. The challenge thus is to bring closer the guidelines from the developer environment in a facility, practical and clear guidance for applying them.

3. DESIGN RATIONALE

Gruber and Russell (1991) and Moran & Carroll (1996) define Design Rationale (DR) as a reference to the reasoning that justifies a project and to descriptions that justify choices structures on other alternatives. MacLean (1989) and Lee (1997) consider that the DR not only includes a description of potential artifact, but also the reasons for decisions, experiences, alternatives and arguments that led to the decision.

Wang and Burge (2010) show that the DR can be used to capture and management architectural knowledge, which is extremely important in software projects including information from the environment and reasons for the design and negotiation process defining the outcome a final product.

However, storing DR can take significant time and be expensive. What can you do to try to resolve this issue is to automate the capture process and associate it most with the work object, i.e. the development itself.

The use of the DR helps the learning of a project as a whole and may represent a solution to help designers to identify issues that might otherwise go unnoticed [9], also contributing to inappropriate identification of premises and decrease the tendency of designers in not perceive possible alternatives on important decisions.

The knowledge has demonstrated a decisive factor in today's world, being the focus of the institutions that need to use it, making decisions constantly. Likewise, the DR is recovered to capture and record decisions made on projects and their impacts, good or bad. This is because such decisions can lead to success or failure of a project. Documenting experiences is important to build a knowledge base for future projects by avoiding rework and enabling better decisions.

The explicitness of the DR allows us to offer a common vocabulary, to produce artifacts most complete in less time with less effort and enabling a better maintenance and development, ensuring design quality. But there are limitations that difficult its use in practice, as presented Regla et al. (2000) and Conklin and Burgess-Yakemovic (1996); the developers’ difficulties to retrieve information captured, the difference between information that developers wish to record and that the system allows, the generally of the tools and the not contributing to the natural progression project activities.

Other useful employment of this methodology, according to Dutoit et al. (2006), is to promote collaboration and knowledge among team members, facilitate maintenance and reuse, improve the quality of the artifacts and base new design decisions.

4. METHODOLOGY

To achieve the objectives of presenting concepts, results of the study, planning and deployment of the proposed tool, we adopt initially exploratory and collaborative research to obtain
information from reality, filter them and compose a knowledge base to help developers.

Thus, for planning and development tool we selected the Requirements Engineering (RE) to assist in planning and recording of the necessary functionality. Then, stages were made for analysis (to understand and make inferences about the data) and design (which is the description and implementation of steps to reach the final product or process) [18].

Thus, the first step was to determine what the goals and requirements for application, and then we developed a document with the planning and requirements.

The team assigned in this work composed of undergraduate computer science students, masters and doctorate researchers with work area related to accessibility. With prior knowledge of the team in the area we were able to reduce development time.

Team discussed necessary to approximate the data collected and development decisions with findings of previous studies and the consolidated rules, optimizing and enabling a relationship of knowledge. So we choose the relationship with WCAG 2.0 because it is a set of official guidelines from W3C.

Thus, the tool concepts were defined: it is not enough we only collect information and design decisions about accessibility, there is a need to organize them in accordance with the guidelines established.

User profiles have been defined including the information that each profile will be allowed access into the tool. This is an important point seen in the planning: the collaboration needs some mediation, to preventing duplication of information and invalid data are not kept in tool.

An issue of the methodology was verified as having high importance: the tool must be accessible, and then it has permeated all programming with implementation of verifications and periodic adjustments in its accessibility. Thus, we used successfully the tool AChecker 1 and manual inspections. How some pages require user authentication, we did manual access in AccessibilityUtil and copy its HTML code for subsequent tool checking.

As the first version of our tool become available, we did the planning of how to make the dissemination, which is important for project success. Thus, developers, students and web interested persons were invited by e-mail and using social networks to participate in the project, just as experiences viewers or as content collaborators.

5. TOOL DEVELOPMENT

The tool was developed in PHP language as code for application on the server side, using the JQuery framework for handling events in the interface and using MySQL as the Database Management System (DBMS). This development has required effort for about four months and we are making improvements and refinements to include new features.

AccessibilityUtil allows the users registration to be able to create artifacts, to visualize the ones who have already done assessments, inserting their experiences and project’s decisions, contributing with use’s report and techniques to have the complete criterions of accessibility for each artifact, from a collaboration methodology between the accessibility specialists.

The database model allowed the inclusion of all principles, guidelines and success criteria with their descriptions and codes, as documented in WCAG 2.0. Thus the creation of the database was defined with the creation of 11 tables with associations (relationships) between them, as can be seen in Figure 2.

Besides the content guidelines, this database also includes the registration of users with their personal data, level of expertise and profile if they have administrator or participant permissions.

We choose register the web artifacts, turning the system more flexible, instead of supporting just patterns, for example. In this context, we consider as artifacts any element present in the web construction, which have some accessibility’s consideration.

The administrator can manage the system accepted artifacts types, visualize utilization’s report, list the users and make a mediation of the sent contents.

The participants can create artifacts related to the administrator inserted types, visualize all the system previous registered artifacts and evaluate them.

The artifacts types’ creation helps its better organization, ranking them. As initial categories we have inserted: “patterns”, “tags” and “others”.

The objective of the generic category “others” is to permit flexibility in the initial categorization, in cases of having lots of artifacts in this category, administrators will be able to verify and a new category can be created to arrange them.

The tool was created to support two languages, Portuguese and English, aiming to be international and also to explore the knowledge of researchers from abroad. Its home screen in the English interface can be seen in Figure 3, below.

1 http://achecker.ca
The Figure 4 shows the main page presented to the participant, in which the user has: the registered artifacts number information from each artifact type contained in the tool, access to the artifact registration page, access to all registered artifacts. Additionally, with the objective of contributing with information retrieve, keyword artifacts search is available too.

As showed in the previous figure, the evaluation can be made by the selection of the accessibility guideline and after choosing the success criterion qualified by guideline selection. The two other fields to be filled out are the accessibility general comments and the accessibility develops difficulty rating.

It’s important to detach that the interface was planned to support the ones who don’t have depth knowledge about WCAG 2.0, showing the related text when the user stays some seconds with the focus or the mouse pointer in each option, by “title” attribute. In case it was a requirement knowing the Guidelines to do the evaluation, it would be an obstacle to the developers, and then, with the AccessibilityUtil offered form helps its dissemination.

From the administrator’s main page, showed in Figure 7, the registered artifacts types appears, it’s possible the generation of user’s accesses and registration, beyond artifacts types creation.

In addition to inserting artifacts, the participant can perform evaluations about the use of accessibility techniques according to a guideline and adding comments in evaluations of an artifact.

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In addition to tool developing, as presented in the previous section, which consumed significant time and effort, allowing the validation of the involved idea in the accessibility DR’s capture, we have as results the its initial application.

Thus, since its recent release in early May, 2011, 206 accesses were computed in AccessibilityUtil tool. In its database were registered 79 users and 76 artifacts distributed in three types according to Table 1, as following.

<table>
<thead>
<tr>
<th>Artifact types</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patterns</td>
<td>37</td>
</tr>
<tr>
<td>Tags</td>
<td>21</td>
</tr>
<tr>
<td>Others</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>76</td>
</tr>
</tbody>
</table>

The selected patterns in this initial registration were selected from Welie (2011) [25] and the Yahoo! Design Pattern Library collection (2011) [26].
name already exists in the system, the participant may make evaluation without having to register it again.

In each artifact can be inserted images to illustrate it and collaborate with its description. For accessibility reasons, each image, to be sent, requires its textual description.

About the evaluations made until late June 3, we have the results shown in Table 2.

### Table 2 - Collaborations in the tool

<table>
<thead>
<tr>
<th>Collaboration types added</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiences</td>
<td>378</td>
</tr>
<tr>
<td>Images</td>
<td>49</td>
</tr>
<tr>
<td>Comments</td>
<td>143</td>
</tr>
<tr>
<td>Total</td>
<td>570</td>
</tr>
</tbody>
</table>

This successfully initial use of the tool, with positive users' feedback, brings confidence to the proposed database model. We verified that this model completed its function capturing and transmitting DR in web accessibility field, which requires everyone’s efforts to improve the inadequacy situation of many artifacts in relation to established guidelines.

Another positive point was some definitions made that don’t involve the data’s model, as the choice of name and domain in the application: for the wider coverage of the project, including international was chosen their access through the domain ".com". This important feature allows the project don’t being associated with an institution’s domain, because it involves different institutions and others may join as partners.

Whereas the project is open for the user to insert images into the artifacts database, and for protection, the sent was limited to the maximum of 7 images per artifact. Thus, we do not have the risk of a user tries, by the use of any tool, overloading the server.

Another interesting result feature is in relation to different reports that can be generated from the AccessibilityUtil tool database. Such reports involve different views, for example, knowing which success criterion was most commented by the contributors and which artifacts it applies. This report can be seen in Figure 8, indicating the evaluations number per success criterion.

![Table 2 - Collaborations in the tool](image)

Analyzing the tool’s data, as the ones seen in Figure 8, we can make relationships and investigations with the evaluations results and comments inserted. For example, we can know the reasons for users don’t send artifacts development experiences in a particular guideline.

We can make good measurements on the sharing of experiences in the tool through a qualitative analysis. Some rich examples are given below:

- **Success criterion**: 3.1.1 - Language of Page
- **Artifact**: `<p>` (tag)
- **Experience reported**: "The paragraph attracts the user attention. It makes him look at the text, starts reading and then want to read the whole text. A text without paragraph is boring; it's neither organized nor interesting".

- **Success criterion**: 2.1.1 - Keyboard
- **Artifact**: `<select>` (tag)
- **Experience reported**: "The combo-box make the navigation easier. It helps not just people with difficulty, but it helps everybody sparing us to type something that is already defined. Instead of typing it you can just click in the word and it's ready".

- **Success criterion**: 1.3.1 - Info and Relationships
- **Artifact**: Accordion menu (pattern)
- **Experience reported**: "Accordions are a good way to organize a web site. It's just necessary to be read by the program-reader. The accordions make faster the localization of subjects in the site, because everything is divided in topics, so the navigation becomes easier".

Therefore, the main contributions of this work can be summarized as following: i) connect participants with accessibility guidelines to allow visualizations from different points of view for the same evaluation; ii) participants cooperation to the completeness of experiences and views about accessibility guidelines for a particular artifact, iii) creation, development and dissemination of a practical experiences about development with usability relating it with artifacts and official guidelines and iv) enable consulting about already evaluated artifacts presenting important data to novice developers, providing good practices learning and identification of inadequate premises.

We note that these contributions are valued within a valorized context at these days, the collaboration by different researchers and others society’s actors to achieve greater accessibility in relation to scientific and technological advances.

### 7. RELATED WORK

When searching about tools for this field, it was verified that the majority seeks to deal with the accessibility in already developed elements, making its evaluation according to guidelines. Differently of these, the AccessibilityUtil tool aims to be used during the analysis and development processes. So, it’s expected to arrive in the assessment time with the less number of errors as possible, considering also the cost of modifications after an effectuated development is much higher than if the correction, or good development, had been practiced in previous stages.

Bailey and Pearson (2011) describe a web tool’s development of accessibility knowledge administration, called Accessibility Evaluation Assistant (AEA), focalized in help the accessibility evaluation process for novice appraisers.

These authors reported that evaluation tools aren’t easily understood for these users yet. One of the causes is the hard
An idea presented by these authors that deserve to be pointed out is the organization of special necessities users in 10 groups: dyslexics, learning disabilities, low vision, physical disabilities, English as a foreign language, elderly, visual impairments in color perception, hearing impairments and seizure disorders.

This organization’s motive, according to the authors, is to help the evaluators to recognize real users and encourage them to find commons accessibility principles that aid in the accessibility verification process. It can be incorporated in the explained tool of this paper over time, but the own guideline is already discoursed about which disability they’re applied.

AccessibilityTips.com already has offered a collection of tips, guidelines and practical suggestions for accessible web development. Its format differs from the developed work in AccessibilityUtil proposed here, because that is structured as blog form, it is not possible the collaboration between users (inclusively the commentaries option is disabled). In such case, all the posts are from a unique author. Another characteristic that differ them is that in this site there is no relation between the suggestions presented and the official guidelines from W3C. One point that must be jutting out is that the last post of this site is reported on 2009, indicating a possible downgrade and discontinuity.

In relation of the DR use, involving the description of experiences related to accessibility, it was not found significant published researches. The performance line realized in this work comes to turn the hypothesis about the benefit of the alliance between the two areas valid. We verified it’s a way to get a proven benefit the hypothesis about the benefit of the alliance between the two areas valid. For this, they developed an extension for the application called Software Engineering Using RATIONALE (SEURAT) [23].

The differentiation to the AccessibilityUtil is that the SEURAT is not web, being a plug-in for the IDE Eclipse's tool, and there’s not the specification to deal with accessibility in accessibility patterns.

We have verified that the undertaken work for the proposed AccessibilityUtil tool presents innovations in order to relate developer’s discussions and comments with the officials Guidelines, allowing an incentive for the collaboration between developers about good practices dissemination as guaranty of accessibility.

8. CONCLUSION

In this work, the purpose was to show the project’s decisions, planning, development and results of a collaboration tool for evaluation with the use of DR of pre-registered artifacts and for artifacts registered by the own participants.

The idea behind the work is to associate artifacts present on web with the W3C accessibility guidelines; for it we picked up and fed the tool with the WCAG 2.0’s guidelines. We hope that it can contribute to approximate experiences of development real cases (in artifacts form) to the guidelines and allow the collaboration with comments between developers and stakeholders.

Through the system access and assessment’s comments, we’ll have conditions to evaluate what issue is considered by the tool development’s staff as its strong point: use DR to help developers choosing which techniques to use.

The tool has been divulged in the community among the different expertise for assessment of numberless artifacts created by them. From the generation of artifacts suitable with the accessibility Guidelines documented by WCAG 2.0, it’s intended in a near future, associate the artifacts with models, based on the objects oriented development methodology.

As another future work, another guideline’s sets will be able to be added to the system, with the purpose of advance in the accessibility requisites and turn the artifacts more and more accessible. Another possibility is to integrate the comments about the artifacts in development’s environments as models, making easier the developer’s use, who will be able to visualize recommendations and practical experiences in development’s mode, for example, by dragging and dropping an element and then appears advice’s texts and guidelines helping him.

9. ACKNOWLEDGMENTS

Our acknowledgments to the Institute of Mathematics and Computer Sciences - University of São Paulo (USP) and also to the FAPESP, project number 2010/05626-7.

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